Is the overall German personal income distribution constant or variable over time? Cross-section analyses for Germany 1969-2003

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Zusammenfassung*

Das Papier beschäftigt sich mit der Entwicklung der bundesdeutschen personellen Einkommensverteilung in Zeitverlaufsperspektive. Indem die jeweiligen Äquivalenzskalen variiert werden, wird analysiert, ob dies nennenswerte Reaktionen auf die gemessene Ungleichheit und Armut auslöst. Der Hauptbefund ist der folgende: Obwohl es – auf der Gesamtebene – ein wenig Variation bezüglich der Verteilungsergebnisse gibt, sind die berechneten Werte vergleichsweise robust. Gleichwohl gibt es immerhin eine gewisse Ergebnisvariation, und außerdem würden die Ergebnisse viel stärker variieren, wenn eine wesentlich stärkere soziodemografische Differenzierung vorgenommen würde als in diesem lediglich illustrativen Papier.

Summary*

This paper deals with the development of the German personal income distribution in a time perspective. By varying the underlying equivalence scales I analyze whether there are worth mentioning reactions of the measured inequality and poverty due to such variations. My main finding is as follows: Although there is some variation concerning the distributional results all in all – on the overall level – the computed values are comparatively robust. Nevertheless there is at least some variation of the results, and furthermore it is probable that the results would vary to a much greater extent if there would be made a much stronger sociodemographic differentiation than in this merely illustrative paper has been done.

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Inhalt

1. Introduction[1]

In general there is a wide range of results concerning the personal income distribution due to methodical settings. This includes the income definition or more general: the definition of the used well-being indicator, the selection of the unit of the analysis, and the standardizations in consequence of different household sizes and structures. Especially comparisons of the well-being between different household types are complicated. So it is difficult to decide whether a two-persons household's income should be e. g. 1,500 € or e. g. 1,700 € in order to reflect the same level of well-being a single-person household with an income in the amount of 1,000 € has.

Although there is a widely common sense that extreme settings like 1,000 € ("per household perspective") or 2,000 € ("per capita perspective") for the bigger household are not acceptable, there is no agreement concerning the settings between these extreme values. Because of this divergence the aim of this paper is to show how sensitive distributional results are with respect to the sketched settings.

In this context the term "stability" is of outmost importance. As a matter of principle, stability can be interpreted in two ways: in a time, a describing perspective and in a methodical, i. e. in a sensitivity sense. The focus of the paper primarily is on the second topic, but several times time-based results will be presented too.

As data base the official German Income and Expenditure Surveys *(EVS: Einkommens- und Verbrauchsstichproben)* for the years 1969 until 2003 were used. The *EVS* are collected by the German Statistical Office since 1962 at intervals of nearly five years. The *EVS* are cross-sectional data bases, and they contain approximately 45,000-60,000 households and more than 100,000-120,000 persons. The participants of the surveys have to list their incomes and expenditures in a detailed manner.[2]

The paper is structured as follows: Firstly in chapter 2 the concept of equivalence relations will be discussed. This discussion comprises the definition of equivalence relations, two general approaches to determine such relations, and the evaluation of estimated equivalence relations. Afterwards chapter 3 deals with theoretical aspects of measuring inequality and poverty by considering the importance of equivalence relations. In the chapters 4 and 5 empirical sensitivity findings with reference to income inequality and relative income poverty will be analyzed. Last but not least concluding remarks are the topic of chapter 6.

2. The methodology

2.1 The definition of equivalence relations

Well-being comparisons between households of different size or (age) structure require the standardization of the used well-being indicator. If household income is taken as such an indicator[3], the household incomes have to be transformed to household equivalence incomes by dividing the household incomes through so-called equivalence relations. An equivalence

[1] I would like to thank Mr. Prof. em. Dr. Richard Hauser, University of Frankfurt/Main, for granting access to the older data bases and Mr. Prof. Dr. Wolfgang Glatzer, also University of Frankfurt/Main, for providing the opportunity to work with the newest used data base of the year 2003. Furthermore I am very grateful to the German Statistical Office – the *Statistisches Bundesamt* in Wiesbaden – for transferring the data base as anonymized micro data files to the scientific community in Germany, especially of course to the professorships named at the beginning of this footnote.

[2] With regard to the conceptual framework of the *EVS* see e. g. Becker/Hauser 2003, p. 71-81.

[3] Alternatively wealth and private consumption could be used as well-being indicators (see e. g. Faik 1995, p. 36-39).

relation reflects the economies of scales which arise in bigger households, e. g. because of price respectively cost advantages in bigger than in smaller households. Additionally, an equivalence relation covers different needs between the household members.[4]

Typically, the first person in a household receives the weight 1.0, further adult household members obtain weights less than 1.0, and further young persons in a household are connected with a weight which firstly is less than 1.0 too, and secondly it is less than the weight of a further adult household member. These weights constitute an equivalence scale. The sum of the weights in the context of a household is called an equivalence relation.

In this sense an example for such a scaling is 1.0 for the first household member, 0.7 for further adult household members, and 0.5 for further young household members.[5] Now the equivalence relation is the sum of such weights in the context of a household. In the example of a household consisting of two adults and two children, the corresponding equivalence relation is 1.0 + 0.7 + 0.5 + 0.5 = 2.7. If the household can dispose of an income in the amount of 2,700 €, the corresponding equivalent household income is 2,700 € divided through 2.7, i. e. 1,000 €.

2.2 A general two-dimensional equivalence relations approach

Our sensitivity analyses partly focus on a general equivalence formula of Buhmann et al. which only depends on household size:

(1) $G^h = S^\theta \quad (0 \le \theta \le 1)$.[6]

In formula (1) G^h represents the equivalence relation of household type h (with respect to the reference household type, in this case a single-person household), S is the abbreviation for household size, and θ is the elasticity of the equivalence relation with regard to the household size (η_{GS}). The latter aspect can be shown as follows:

(2) $\eta_{GS} \equiv \frac{dG}{dS} \cdot \frac{S}{G} = \theta \cdot S^{\theta-1} \cdot \frac{S}{S^\theta} = \theta \cdot$

E. g., if θ equals 0.5 then η_{GS} also amounts to 0.5. This means that an increase in household size in the amount of 100 per cent (e. g. from a single-person household to a two-persons household) leads (averagely) to an increase of the equivalence relation in the amount of 50 per cent.[7] The higher θ is, the higher the scale elasticity is (on average).

In the case of θ = 0.0 the equivalence relation corresponds to a weight for the household's head in the amount of 1.0, and all other household members receive a weight in the amount of 0.0. Such a weighting can be denoted as a per household weighting because all households – independent of household size and structure – obtain the weight 1.0. If θ equals 1.0, all household members are referred to a weight of 1.0. This weighting is the same as a per capita weighting of the household incomes.

[4] Basically see Faik 1995.

[5] As we will see later on, this scale is the so-called old OECD scale.

[6] See Buhmann et al. 1988, p. 119.

[7] Strictly spoken, this interpretation is not completely permitted because the elasticity formula is restricted to infinitesimal small variations of S.

2.3 A general three-dimensional equivalence relations approach

In the case of a three-dimensional perspective of the equivalence relation G^h with respect to the degression effects of household size on one hand *and* the age-dependency of needs on the other hand a more comprehensive approach was proposed by Citro/Michael:[8]

$$(3)\quad G^h = \left(E + \alpha \cdot K\right)^{\theta} \quad \left(0 \le \theta \le 1,\ 0 \le \alpha \le 1\right).$$

In formula (3) the number of adults is represented by E, and K is the number of children in a household. Once more θ is a synonym for the economies of scales, and α reflects the needs of a child in relation to an adult. Obviously, now the above scale formula which Buhmann et al. had chosen is split in the sense that the household size is divided in two age groups, children and adults.

In this context it is assumed that the needs of a child are not bigger compared to an adult because α has the value 1 as its upper limit. In the case of $\theta = 0$ the scale formula represents the "per household case"; i. e. all equivalence relations amount to the value 1. If θ equals 1 as well as α does, the household incomes are divided through the household size. Therefore this situation reflects the "per capita case".

On the basis of formula (3) once more (partial) elasticities can be computed:

$$(4)\quad \eta_{GE} \equiv \frac{\partial G}{\partial E} \cdot \frac{E}{G} = \theta \cdot \left(1 + \frac{\alpha \cdot K}{E}\right)^{-1} \quad \wedge \quad \eta_{GK} \equiv \frac{\partial G}{\partial K} \cdot \frac{K}{G} = \theta \cdot \left(1 + \frac{E}{\alpha \cdot K}\right)^{-1}.$$

E. g., for a household consisting of one adult and one child at $\theta = 0.8$ and $\alpha = 0.7$ the elasticities are: $\eta_{GE} \approx 0.47$ and $\eta_{GK} \approx 0.33$. In this case an one-hundred per cent increase in the number of adults – on average and crudely spoken[9] – leads to an increase in the equivalence relation in the amount of 47 per cent. An one-hundred per cent increase in the number of children results – averagely – in a smaller positive change of the equivalence relation (circa 33 per cent).

2.4 Comparing equivalence scales

In the following table some widely used equivalence relations are listed.

Table 1: Overview concerning different equivalence relations

Household type	Per household	US Poverty line	New OECD scale	US Poverty Commission	Old OECD scale	Per capita
1 adult	1.00	1.00	1.00	1.00	1.00	1.00
2 adults	1.00	1.29	1.50	1.62	1.70	2.00
2 adults, 1 child	1.00	1.53	1.80	2.00	2.20	3.00
2 adults, 2 children	1.00	1.96	2.10	2.36	2.70	4.00
2 adults, 3 children	1.00	2.27	2.40	2.69	3.20	5.00
2 adults, 4 children	1.00	2.62	2.70	3.00	3.70	6.00

Sources: Faik 1997, p. 17, and Citro/Michael 1995

[8] See Citro/Michael 1995, p. 161.

[9] See my remark in footnote 7.

The values of the old OECD scale are relatively high.[10] This represents the assumption of relatively low economies of scale as well as relatively high needs of children compared to adults. Other scales have much lower scale values, especially the US poverty line scale. Here the weight for the second adult person only amounts to 29 %. So for the transition from a single-person household to a two-adults household economies of scale are assumed in the amount of 71 %. This does not seem to be very plausible. Another source for criticism is the irregular developing of the children's weights: 24 % for the first child, 43 % for the second child, 31 % for the third child, and 35 % for the fourth child.

Because of these problems an US commission tried to install new socio-demographic poverty lines for the USA. In the so-called Panel on Poverty and Family Assistance members of the Committee on National Statistics, of the Commission on Behavioural and Social Sciences and Education, and of the National Research Council worked together on the design of a new institutional poverty-based equivalence scale. After comprehensive analyses of literature and data they referred to the Citro/Michael equivalence formula, and they suggested to take $\alpha = 0.7$ and $\theta = 0.65\text{-}0.75$.[11] This means that the assumed needs of children compared to adults amount to 70 % and that the assumed economies of scales are substantially less than in the original US poverty line scale.[12]

As we already have seen in table 1, the new US scale is relatively close to the old OECD scale, whereas the old US scale is relatively close to the new OECD scale.[13] The old OECD scale can be approximated comparatively well by the Citro/Michael scale with $\alpha = 0.7$ and $\theta = 0.8$. A similar approximation can be done for the new OECD scale: In this case the Citro/Michael scale values are (approximately) $\alpha = 0.7$ and $\theta = 0.6$. These coherences are shown in table 2.

Table 2: Approximations of the new and the old OECD scale by the Citro/Michael scale

Household type	New OECD scale	Citro/Michael scale: $\alpha = 0.7$, $\theta = 0.6$	Old OECD scale	Citro/Michael scale: $\alpha = 0.7$, $\theta = 0.8$
1 adult	1.00	1.00	1.00	1.00
2 adults	1.50	1.52	1.70	1.74
2 adults, 1 child	1.80	1.81	2.20	2.21
2 adults, 2 children	2.10	2.08	2.70	2.66
2 adults, 3 children	2.40	2.33	3.20	3.09
2 adults, 4 children	2.70	2.56	3.70	3.51

Source: Own compilation

[10] In the old OECD scale children are aged until 14 years, and "adults" are persons in the age of 15 years or more.

[11] In table 1 the stated values of the so-called new US poverty line scale are based on $\alpha = 0.7$ and $\theta = 0.7$.

[12] See Citro/Michael 1995, especially p. 178.

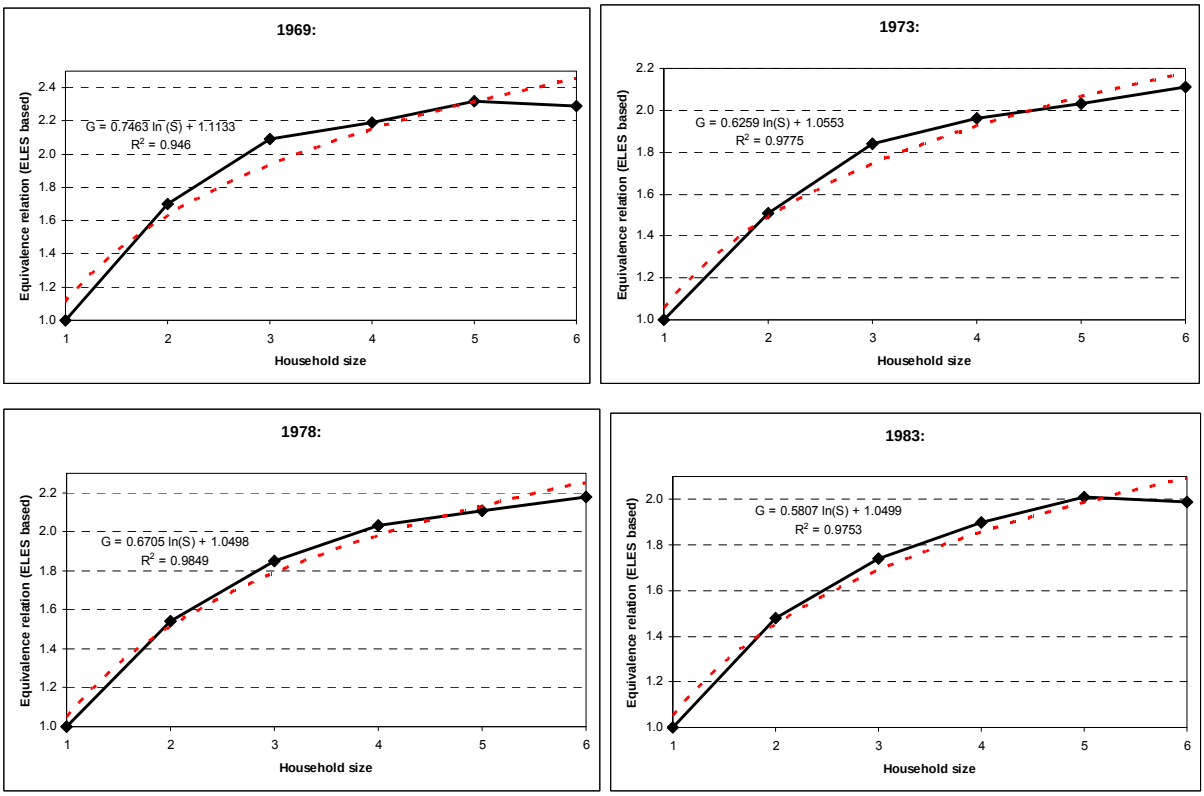
[13] As the old OECD scale, the new OECD scale differentiates between children in the age until 14 years and "adults" in the age of 15 years or more.

2.5 Equivalence relations: Empirical findings for Germany

In figure 1 empirically estimated equivalence relations are presented.[14] They are based on an expenditure system which is consistent with traditional microeconomic assumptions. Concretely the Extended Linear Expenditure System (ELES) was used.[15] The presented estimations are differentiated by household size only. This is because the computations merely have an illustrating character.

All derived scales are connected with subsistence income levels. At the subsistence income level in 2003 (circa 14,400 € p. a.) – to take the newest available data base – the equivalence relations from single-person households to six-persons households are: 1.00; 1.65; 1.78; 1.92; 2.13; 2.16. This reveals low (and partly irregular) weights starting with the third household member (0.13; 0.14; 0.21; 0.03).[16]

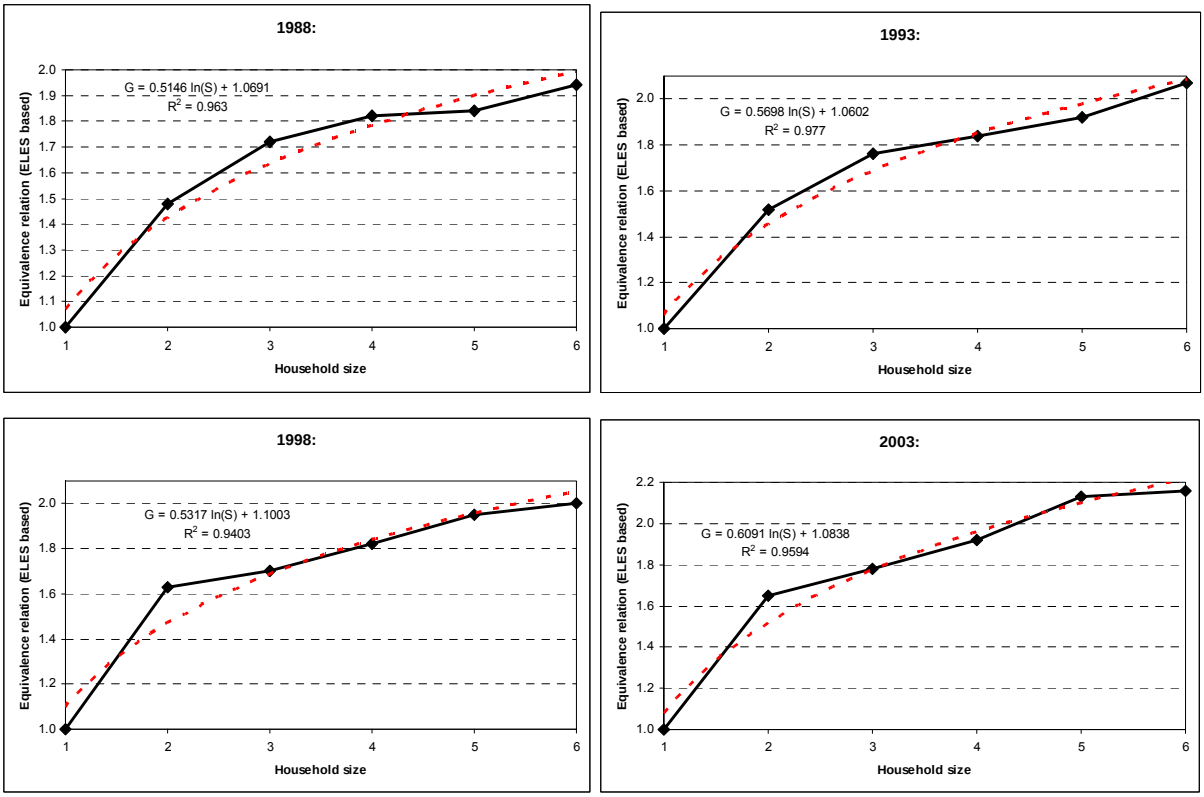
Figure 1: The empirical ELES based equivalence relations and regression approximations, (Western) Germany 1969-2003*



[14] See Faik 1995, Merz/Faik 1995 and new computations. The underlying OLS estimators plus their significance levels can be ordered from the author.

[15] With regard to the socio-demographic functionalizing of the ELES see the basic work done by Merz 1980.

[16] The OLS estimates are limited to a household size of six persons for comparative reasons because in the older data bases (until 1983) the variable “household size” only comprised the values one until six persons.



* 1969-1988: Western Germany, 1993-2003: Germany as a whole; the solid lines represent the ELES estimated scale values and the dotted lines the regression model values

Sources: Own computations (partly based on Faik 1995, p. 244-245, and Faik/Hauser 1998, p. 67 and p. 96)

The estimated regression functions in figure 1 represented by the dotted lines state regular scale patterns. They idealize the empirical ELES scales. It is evident that the (regressive) adjustment to the empirical equivalence relations is very well: The (adjusted) determination coefficients amount to values between 0.94 and 0.98 (which is in some sense trivially connected with the semi-logarithmic elements of the ELES cost function[17]).

Therefore the estimated regression functions $G^h = a + ß \ln(S)$ can be used to compute elasticities:

$$(5)\quad \eta_{GS} \equiv \frac{\partial G}{\partial S} \cdot \frac{S}{G} = \frac{ß}{S} \cdot \frac{S}{a + ß \cdot \ln(S)} = \frac{ß}{a + ß \cdot \ln(S)}.$$

Because of the conditions that a) the minimum of the equivalence relations has to amount to 1.0 and that b) the constants of all regression adjustments are close to this value we obtain for our estimated regressions the approximation $G^{h*} = 1 + ß \ln(S)$.

Henceforth the general elasticity formula is:

$$(6)\quad \eta^{*}_{GS} \approx \frac{ß}{1 + ß \cdot ln(S)}.$$

It is obvious that η^*_{GS} decreases with S.

Table 3 contains corresponding elasticity estimates for (Western) Germany 1969-2003. We find the expected decreasing pattern of the elasticity values. Typically the elasticities range

[17] See e. g. Faik 1995, p. 133.

from 0.5 to 0.75 for the first person, from 0.35 to 0.5 for the second person, from 0.3 to 0.4 for the third person, from 0.3 to 0.35 for the fourth person, for the fifth person the elasticity amounts to approximately 0.3, and it ranges from circa 0.27 to 0.32 for the sixth person. On average, the elasticities during 1969 and 2003 are (approximately) 0.61 for the first person, 0.43 for the second person, 0.36 for the third person, 0.33 for the fourth person, 0.31 for the fifth person and 0.29 for the sixth person.

Table 3: Elasticity estimates, ELES equivalence relations, (Western) Germany 1969-2003*

Year:	1 person	2 persons	3 persons	4 persons	5 persons	6 persons
1969	0.7463	0.4919	0.4101	0.3668	0.3391	0.3193
1973	0.6259	0.4365	0.3709	0.3351	0.3118	0.2950
1978	0.6705	0.4578	0.3861	0.3475	0.3225	0.3046
1983	0.5807	0.4140	0.3545	0.3217	0.3002	0.2846
1988	0.5146	0.3793	0.3287	0.3003	0.2815	0.2677
1993	0.5698	0.4085	0.3504	0.3183	0.2972	0.2819
1998	0.5317	0.3885	0.3356	0.3061	0.2865	0.2723
2003	0.6091	0.4283	0.3649	0.3302	0.3076	0.2912
Mean value	0.6061	0.4256	0.3627	0.3283	0.3058	0.2896

* 1969-1988: Western Germany, 1993-2003: Germany as a whole

Source: Own computations for the equivalence relations shown in figure 1

The average value of these means is approximately 0.41.[18] Therefore as a crude approximation – with regard to the Buhmann et al. approach – the presented scale elasticities on average amount to $\theta = 0.4$.

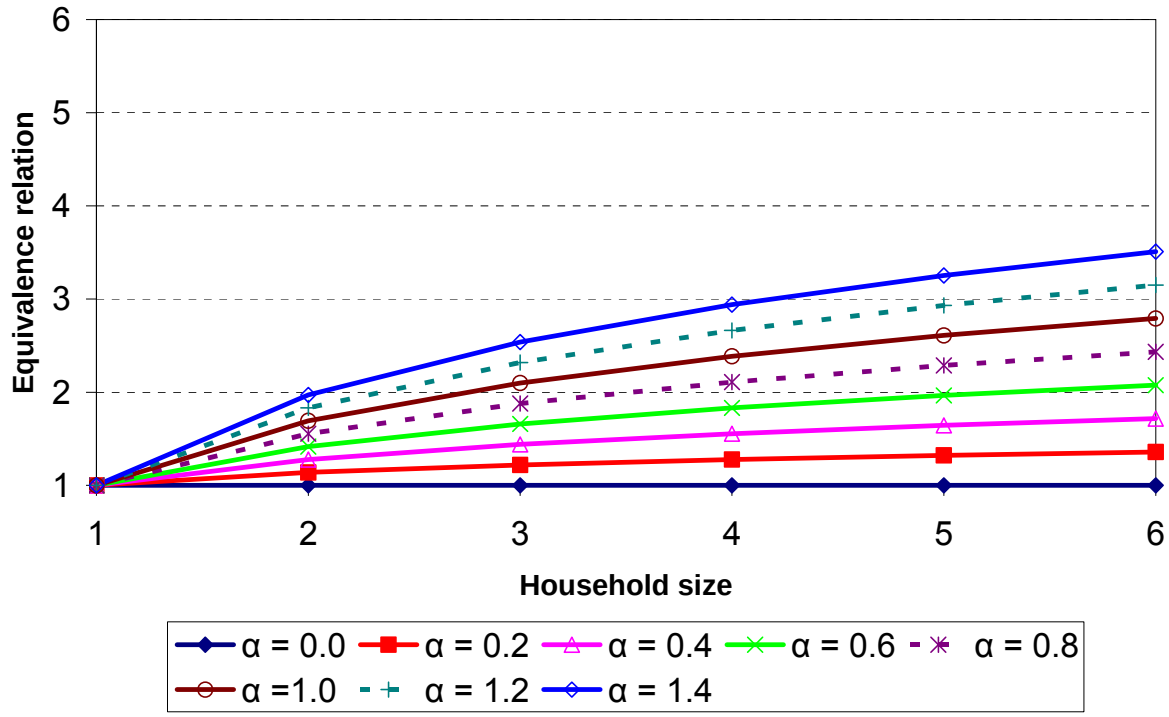
3. Theoretical aspects of inequality and poverty measurement with respect to equivalence relations[19]

General equivalence relations like the Buhmann et al. or the Citro/Michael formulation can be used to make sensitivity analyses concerning income inequality and poverty. Such analyses require the variation of the parameters θ and α starting with $\theta = 0.0$ and $\alpha = 0.0$ ("per household perspective"), and ending with $\theta = 1.0$ and $\alpha = 1.0$ ("per capita perspective"). An alternative approach in this respect is the semi-logarithmic equivalence relation which was presented in the former chapter. In this context the parameter ß has to be varied. If ß amounts to 0.0, this is the per household case. The higher ß is, the higher the equivalence relations are, i. e. the economies of scale decrease. This is shown in figure 2. The highest value for α we should use is approximately 1.44 because higher values of α lead for a two-persons household to an equivalence relation in the amount of more than 2.0 which is not plausible.

[18] The overall mean is computed as a weighted mean. As weights the population shares of the different household sizes were used.

[19] See Faik 1995, p. 322-326.

Figure 2: Equivalence relations on the basis of a semi-logarithmic scale operationalization



Source: Own illustration

In the context of inequality it is important how the correlation between household size and household income is. Typically there is a slight positive correlation between these two variables. Starting with the assumption of highest economies of scales and therefore equivalence relations in the amount of 1.0 for all household types, subsequently the economies of scales are reduced stepwise corresponding to higher equivalence relations which means a levelling concerning the equivalent household incomes. Shortly spoken: The measured inequality decreases. But the further dropping of the bigger household's equivalent incomes will lead to an increase in the measured inequality at a certain point. So an u-shaped curve for the inequality levels depending on the economies of scales range is realistic.[20]

In the case of relative income poverty an u-shaped curve for the headcount ratio with regard to gradually decreasing economies of scale is plausible too. This can be justified by the gradually increasing number of poor households with a relatively big size on one hand and the counterbalancing effects of the decreasing poverty line on the other hand. Typically, the poverty line is constructed as a share of the average equivalent income, and because of the declining average equivalent income across the area of θ the relative poverty line decreases as well.

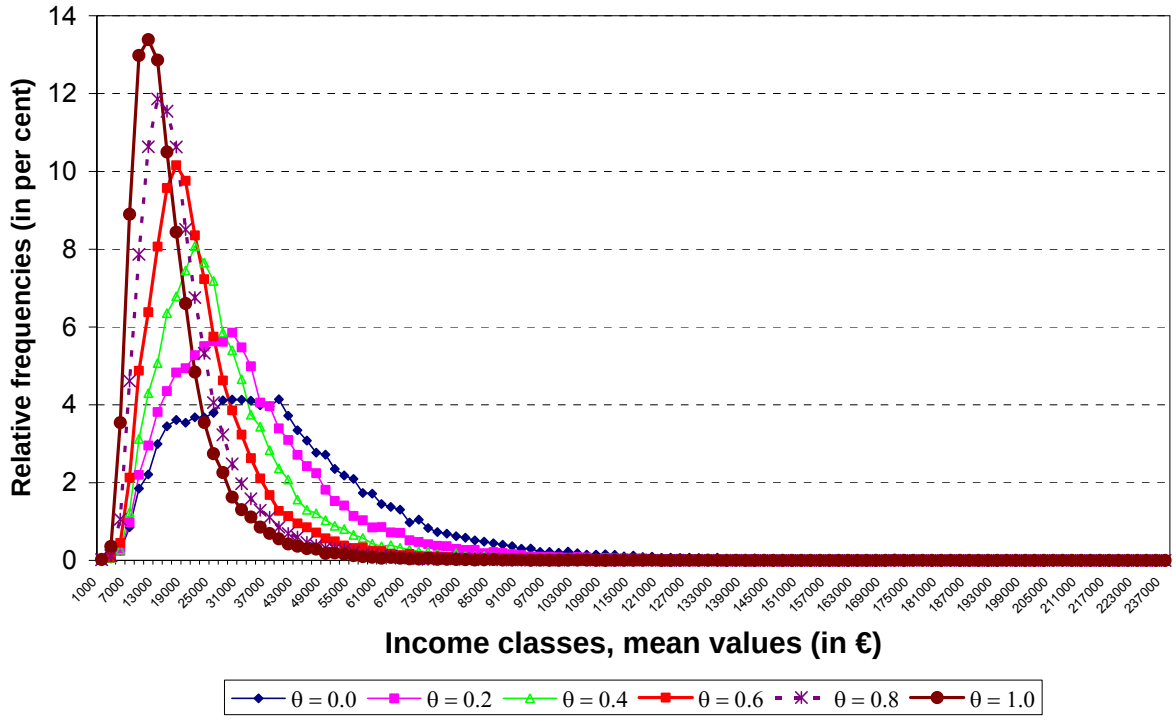
[20] If a negative correlation between household size and household income occurs, it is probable that the inequality curve has a negative slope across the whole area of θ.

4. Income inequality in Germany: Empirical sensitivity findings[21]

4.1 The shape of the personal income distribution in Germany with regard to the Buhmann et al. approach

Figure 3 illustrates the sensitivity of the German personal income distribution in 2003 with respect to the Buhmann et al. scale parameter θ. The higher θ is, i. e. the lower the assumed economies of scales are, the more the relative frequency distributions are skewed to the right. This functional curve results because of the empirical fact (in this context of the used *EVS* data 2003) that the very high equivalence (net) incomes typically correspond to single-person households. Their incomes are divided through 1.0 at each level of θ, i. e. that their equivalence incomes are not influenced by the variation of θ. Associated with this fact the income distributions shown in figure 3 reveal lower dispersions at higher values of θ in relation to lower values of θ. E. g., the standard deviation at θ = 0.0 amounts to 24,259.97 €, whereas at θ = 0.4 it equals 15,026.42 € and it only has the value 10,061.05 € at θ = 1.0. These differences result from a more or less positive correlation between household income and household size. The correlation coefficient for the discussed German income distribution amounts to +0.497 with respect to household size and (non-adjusted) household (net) incomes.

Figure 3: Relative frequency distributions, Germany in 2003, at different levels of θ



Source: Own computations (partly based on Faik 2008, p. 26)

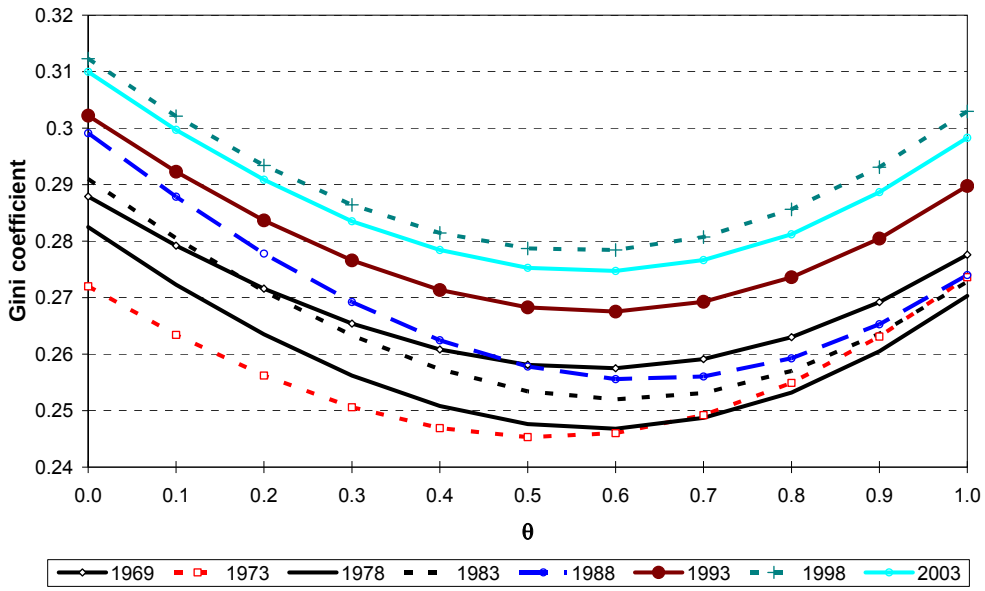
[21] For similar analyses with regard to the United Kingdom see Coulter/Cowell/Jenkins 1992. In chapter 4 and chapter 5 the equivalent household net incomes are weighted by the numbers of persons in each household. This is because individuals achieve well-being and not households.

4.2 The development of income inequality in Western Germany with regard to the Buhmann et al. approach

Because of the mentioned positive correlation between household size and household net income the curve for the Gini coefficient across the range of θ is u-shaped in all considered years for Western Germany. Furthermore in figure 4 there are some intersection points. Firstly the income inequality in 1973 measured by the Gini coefficient was lower than in 1978 to the point of θ = 0.7. Thereafter the inequality in 1973 was higher than in 1978. Secondly the inequality in 1969 was lower than in 1983 and in 1988 from θ = 0.0 until θ = 0.2. Between θ = 0.2 and θ = 0.5 the measured income inequality in 1969 was higher than in 1983 but lower than in 1988. From θ = 0.5 until θ = 1.0 the inequality in 1969 was higher than in 1983 and in 1988. In the years 1993, 1998 and 2003 there are no intersections. All in all we can conclude that from θ = 0.0 until θ = 0.2 the inequality ranking is 1973 < 1978 < 1969 < 1983 < 1988 < 1993 < 2003 < 1998. Between θ = 0.2 and θ = 0.5 we obtain the ranking 1973 < 1978 < 1983 < 1969 < 1988 < 1993 < 2003 < 1998 and between θ = 0.5 and θ = 0.7 1973 < 1978 < 1983 < 1988 < 1969 < 1993 < 2003 < 1998. Last but not least between θ = 0.7 and θ = 1.0 the ranking is 1978 < 1973 < 1983 < 1988 < 1969 < 1993 < 2003 < 1998.

These different rankings demonstrate the importance of equivalence scales in income inequality studies. Nevertheless we obtain as a tendency that in Western Germany the income inequality decreased from the 1960s to the 1970s and then it gradually increased in the 1980s and in the 1990s. After that period it seems to be a fact that the inequality has decreased at the beginning of the new millennium. But all in all the measured inequality differences are relatively small.[22, 23]

Figure 4: Gini coefficients for Western Germany 1969-2003 at different levels of θ



Source: Own computations (see Faik 2008, p. 27, too)

[22] In this context it is necessary to note that the vertical axis of figure 4 starts with the value 0.24 because of a better overview concerning the (small) variations of the Gini coefficient.

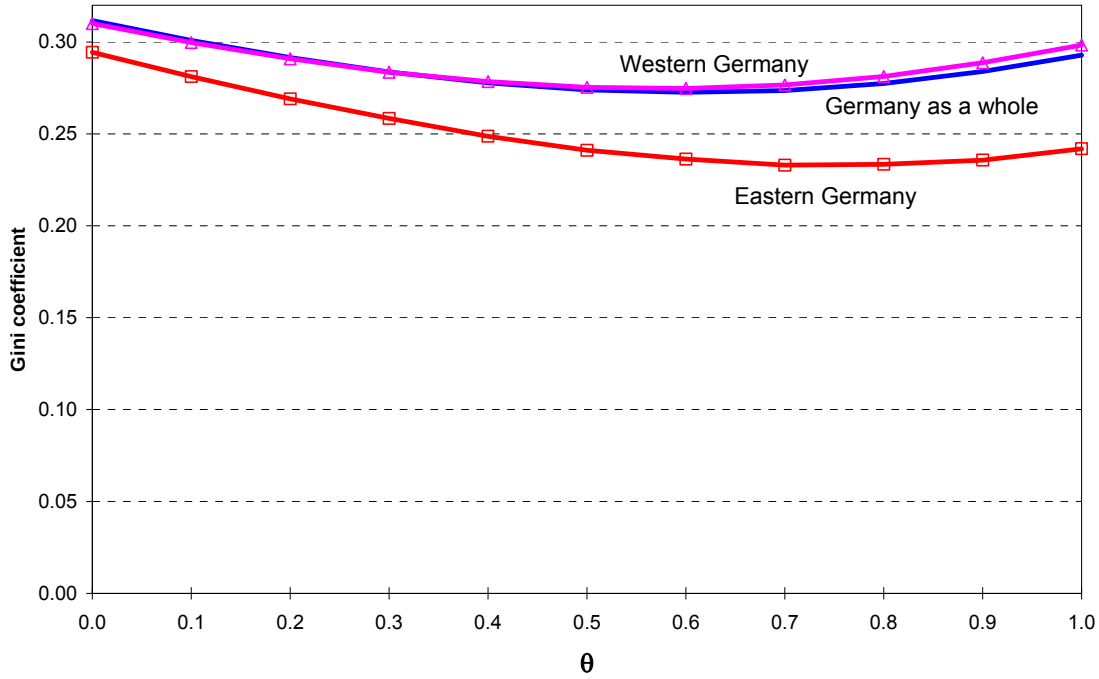
[23] Over the range of θ the measured inequality of the equivalent household gross incomes is higher than the above Gini coefficients for the distribution of the equivalent household net incomes at every point. So the transition from gross to net incomes reduces the measured inequality in the amount of approximately 6-8 per cent. This fact is a crude indicator for redistribution in Germany.

There is some empirical and "animal spirit" evidence to restrict the range of θ, e. g. to a range from θ = 0.4 to θ = 0.8. This includes – approximately – empirical expenditure-based equivalence scales for Germany[24] as well as the above mentioned new and old OECD scales. By acting in this way the mentioned tendencies are strengthened.

4.3 Income inequality in Eastern and Western Germany with regard to the Buhmann et al. approach

Figure 5 shows the sensitivity of the income distributions in Western Germany, Eastern Germany and Germany as a whole in 2003. At all values of θ the measured income inequality in Eastern Germany is lower than in Western Germany and Germany as a whole. Perhaps this reflects the "socialist uniformity" in the German Democratic Republic (GDR) at least to some degree. From θ = 0.0 to θ = 0.3 the measured income inequality between Western Germany and Germany as a whole has nearly the same amount (with slightly higher values of the Gini coefficient in Germany as a whole). From θ = 0.3 upwards the measured income inequality in Western Germany is higher than in Germany as a whole. That means that the relatively low income inequality in Eastern Germany to some degree counterbalances the increasing Western German inequality (with increasing values of θ) at the level of Germany as a whole.

Figure 5: Gini coefficients for Western, Eastern Germany and Germany as a whole in 2003 at different levels of θ



Source: Own computations (see Faik 2008, p. 29, too)

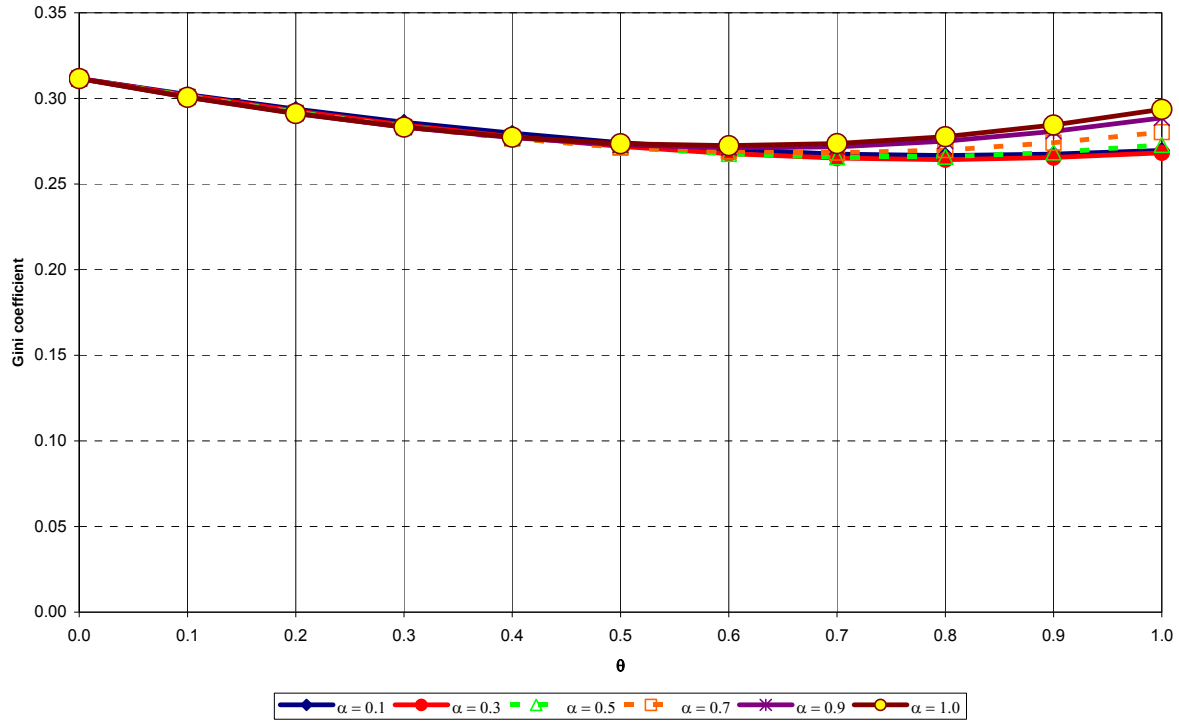
[24] See e. g. Faik 1995, Merz/Faik 1995 and the conclusions drawn in the above chapter 2.5.

4.4 Income inequality in Germany with regard to alternative equivalence relations

Figure 6 represents the transition from using the Buhmann et al. scale to the Citro/Michael scale. In figure 6 the Buhmann et al. approach is captured by α = 1.0.

It is obvious that the previous results with respect to the relation between measured inequality and the parameter θ become confirmed: No big differences in the estimated Gini coefficients exist. There only is a weak tendency for higher inequality values corresponding to increasing values of α starting with θ = 0.6. Restricted to θ = 0.8 and compared to the values of the Gini coefficient generated by the Buhmann et al. formula the inequality values in the Citro/Michael approach are a little bit less and at the same time they are in the (small) deviation range between circa 2 und 5 per cent.

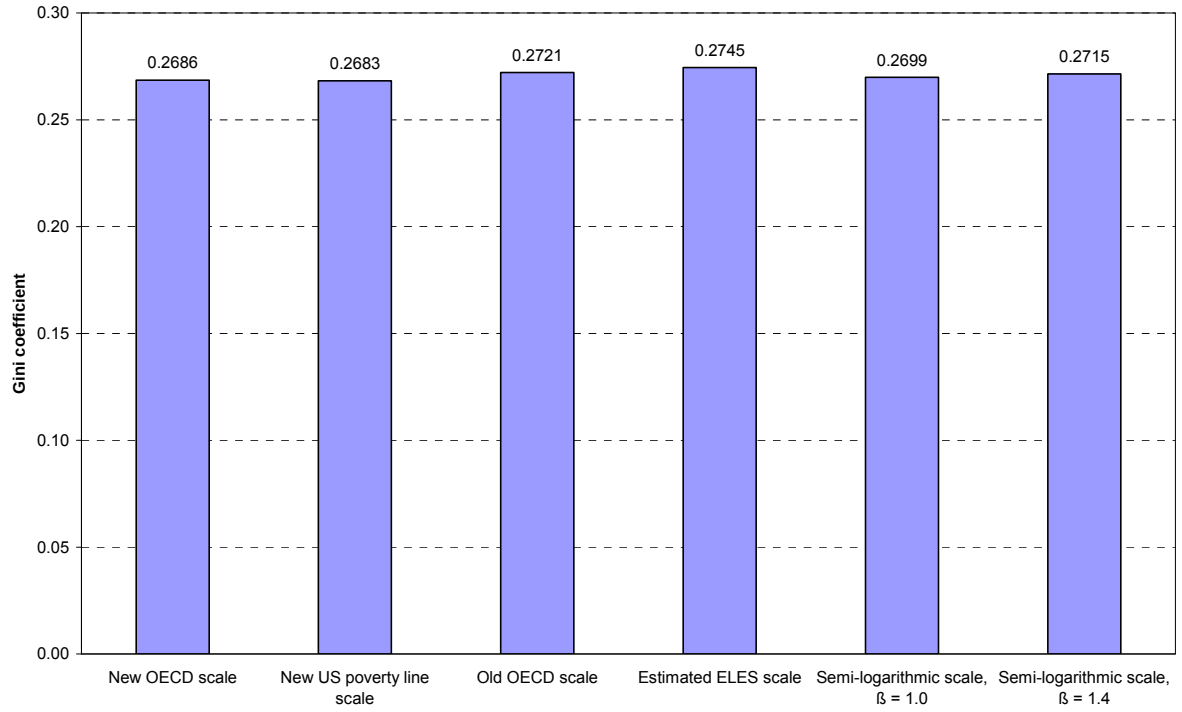
Figure 6: Gini coefficients for Germany in 2003 based on the Citro/Michael formula



Source: Own computations

In another sensitivity analysis the semi-logarithmic formula mentioned in chapter 2.5 is used: In this context we vary ß. Compared to the Buhmann et al. and the Citro/Michael formulas and other equivalence relations the obtained differences are relatively small and the values of the Gini coefficient range from 0.2683 to 0.2745 (see figure 7).

Figure 7: Gini coefficients for Germany in 2003 based on different equivalence relations



Source: Own computations

5. Relative income poverty in Germany: Empirical sensitivity findings

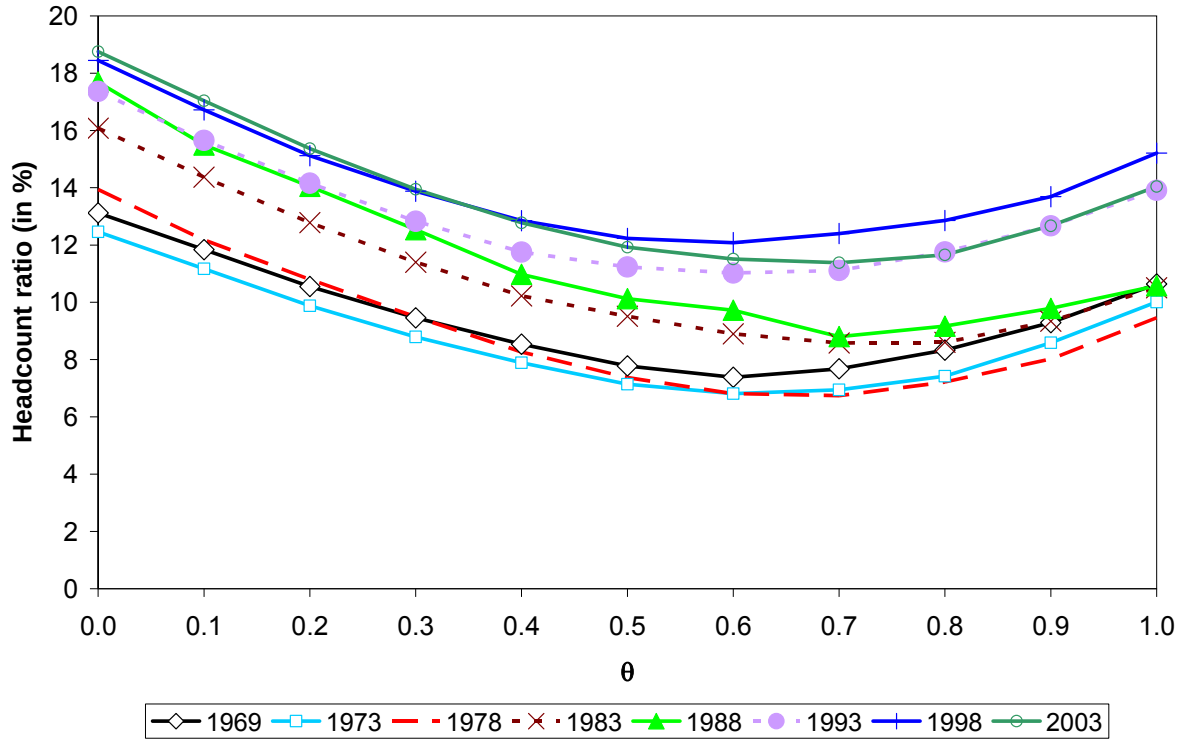
5.1 The development of relative income poverty in Western Germany with regard to the Buhmann et al. approach

Poverty rankings for Western Germany from 1969 to 2003 are made in figure 8.[25] The used poverty measure is the headcount ratio.[26] The figure reveals a much higher dependency of the poverty structure across time with respect to θ than the inequality picture has shown in figure 4. This is because there are a lot of intersections. Only from $\theta = 0.5$ upwards the poverty ordering becomes relatively clear – especially in the sense that the poverty was higher in the 1960s than in the 1970s. In the following decade – the 1980s – the measured poverty was higher than in the 1970s. Additionally, in the years 1993, 1998 and 2003 the measured poverty was higher than before. Thereby a poverty decrease between 1998 and 2003 seems to have occurred.

[25] All poverty computations are made on the basis of a poverty line which is set as 50 % of the mean equivalent household net income whereby the arithmetic mean was selected as mean value. Obviously there a two further sources for variation in the results: The choice of the concrete share (e. g. 40 % versus 50 % versus 60 %) and the selection of the concept of the mean value (arithmetic mean versus median versus mode).

[26] The headcount ratio is defined as relation between the number of the poor and the overall population size.

Figure 8: Headcount ratios for Western Germany 1969-2003 at different levels of θ

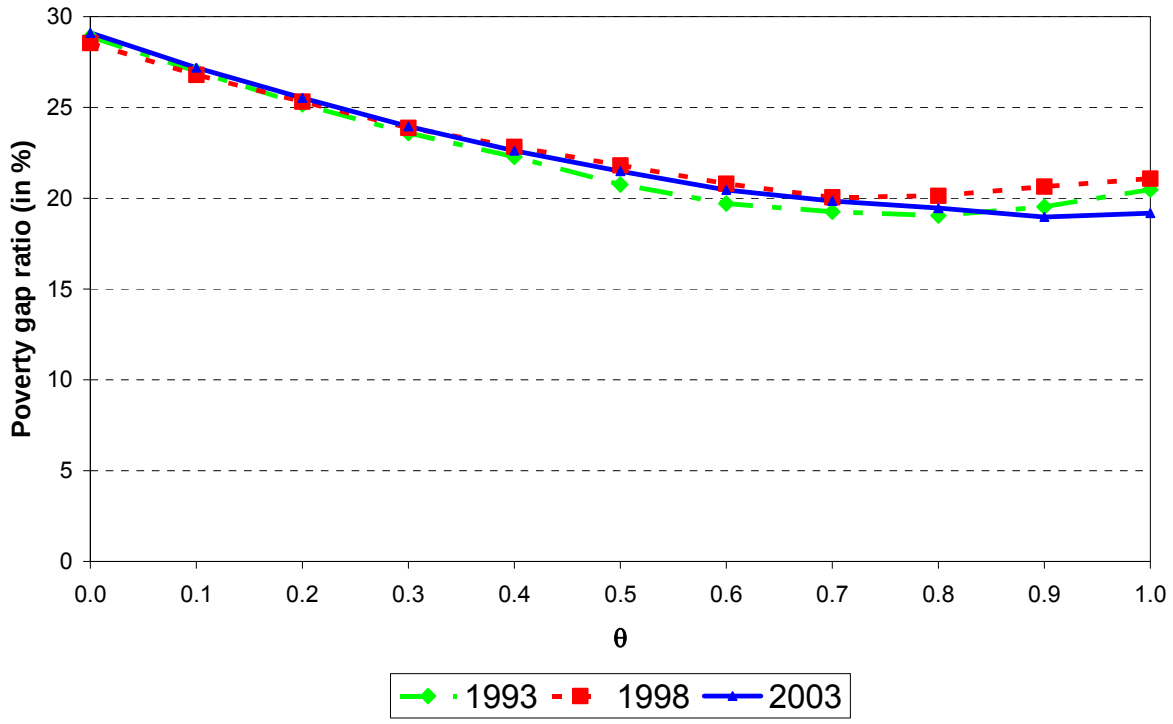


Source: Own computations (see Faik 2008, p. 31, too)

The poverty gap ratio[27] in figure 9 only shows weak u-shaped curves for the presented three years. In all years the poverty gap ratios are ranged from approximately 20 per cent to 30 per cent. Obviously the corresponding differences of the poverty gap ratios between 1993, 1998 and 2003 are very small in Western Germany.

[27] The poverty gap ratio is defined as the lag of the poor's mean (equivalent) income compared with the level of the poverty line and it is measured in per cent.

Figure 9: Poverty gap ratios for Western Germany 1993-2003 at different levels of θ



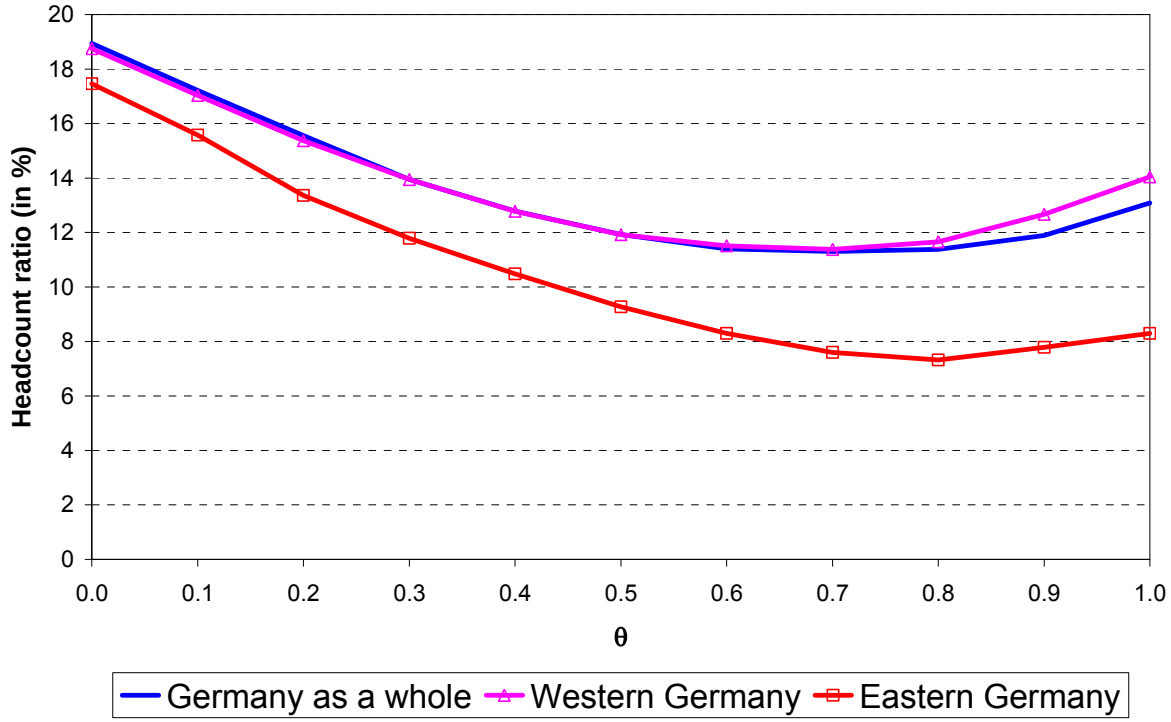
Source: Own computations

5.2 Relative income poverty in Eastern and Western Germany with regard to the Buhmann et al. approach

Comparing the sensitivity of the headcount ratios in Western Germany, Eastern Germany and Germany as a whole in 2003, there is a much lower poverty in Eastern Germany than in the Western part of Germany (see figure 10). In this context it is important to note that the used poverty lines are regional ones, i. e. the measured poverty in Western Germany corresponds to poverty lines exclusively computed for Western Germany, and the poverty of Eastern Germany is measured in terms of an Eastern German poverty line. The use of a general German poverty line would have raised the measured poverty in Eastern Germany (substantially).

In figure 10 the headcount ratios vary in Eastern Germany between approximately 8 per cent and nearly 18 per cent. The range for Western Germany is between 12 and 19 per cent. To the point of $\theta = 0.7$ there are no substantial differences between the headcount ratios in Western Germany and in Germany as a whole. After that point the measured poverty in Western Germany is higher than in Germany as a whole.

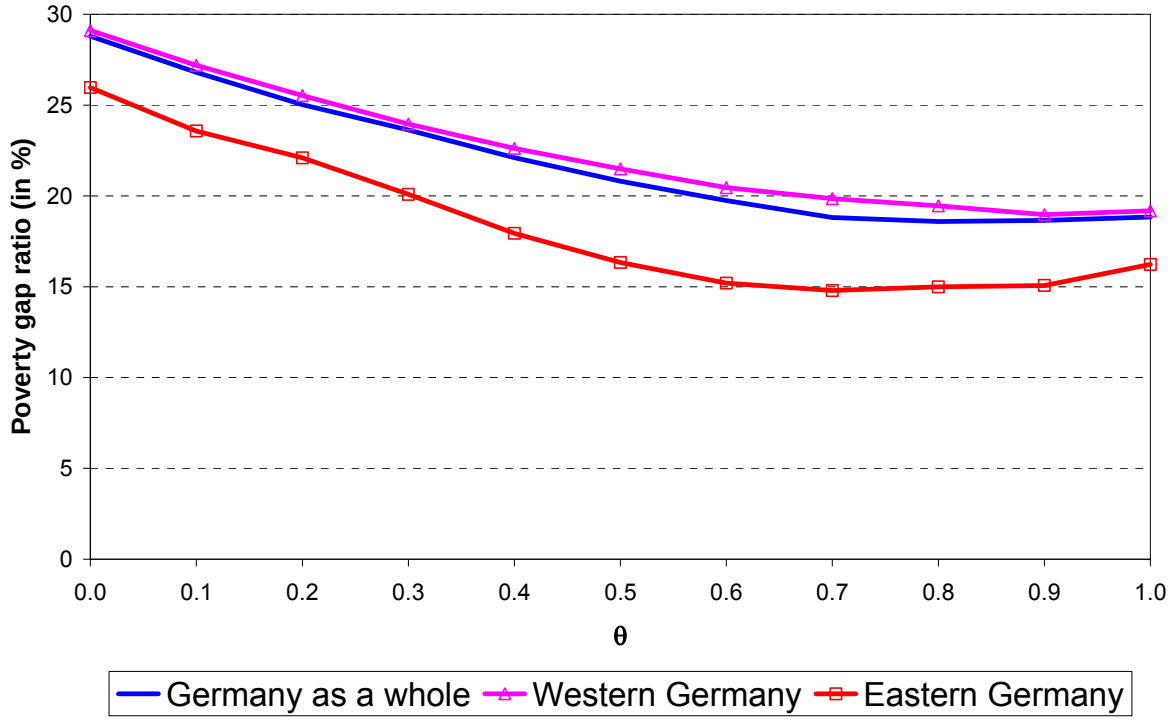
Figure 10: Headcount ratios for Western, Eastern Germany and Germany as a whole in 2003 at different levels of θ



Source: Own computations

Nearly the same pattern as in figure 10 is revealed by figure 11 which uses the poverty gap ratio as a poverty indicator: The poverty gap ratios of Eastern Germany are lower than in Western Germany and in Germany as a whole at all levels of θ. Furthermore, the corresponding differences between Western Germany and Germany as a whole are relatively small – with a tendency of a (slightly) higher poverty intensity in Western Germany.

Figure 11: Poverty gap ratios for Western, Eastern Germany and Germany as a whole in 2003 at different levels of θ



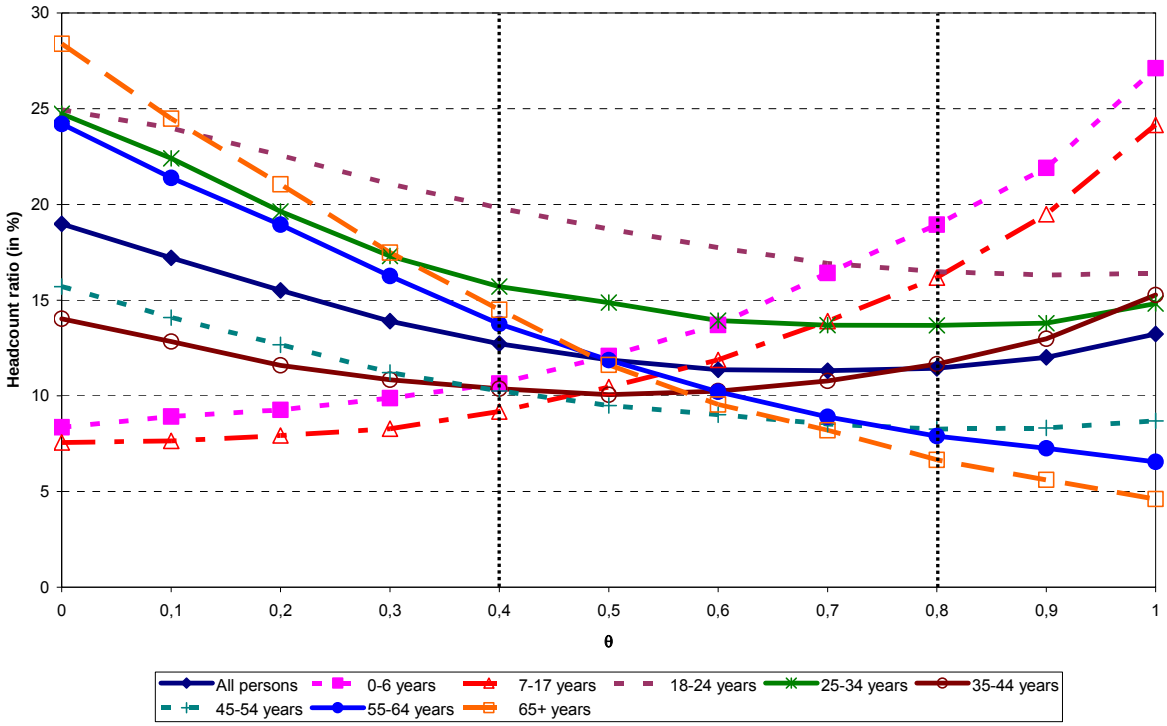
Source: Own computations

5.3 Relative income poverty in Germany in an age-differentiated perspective with regard to the Buhmann et al. approach

Figure 12 shows age-differentiated headcount ratios for Germany in 2003. It is evident that the structure of household types changes with decreasing economies of scales. As it could be expected bigger household types – and on average younger persons live in such households[28] – step by step receive higher shares. In the particularly relevant range θ = 0.4 until θ = 0.8 the share of younger persons is very prominent. Conservatively we can conclude that currently poverty in Germany is especially a problem of young people.

[28] The age groups shown in figure 12 live on average in households with the following sizes: 0-6 years: 4.03 persons, 7-17 years: 4.09 persons, 18-24 years: 3.39 persons, 25-34 years: 3.00 persons, 35-44 years: 3.56 persons, 45-54 years: 3.17 persons, 55-64 years: 2.30 persons, and 65 years and older: 1.97 persons (own computations).

Figure 12: Headcount ratios for Germany in 2003 in an age-differentiated perspective

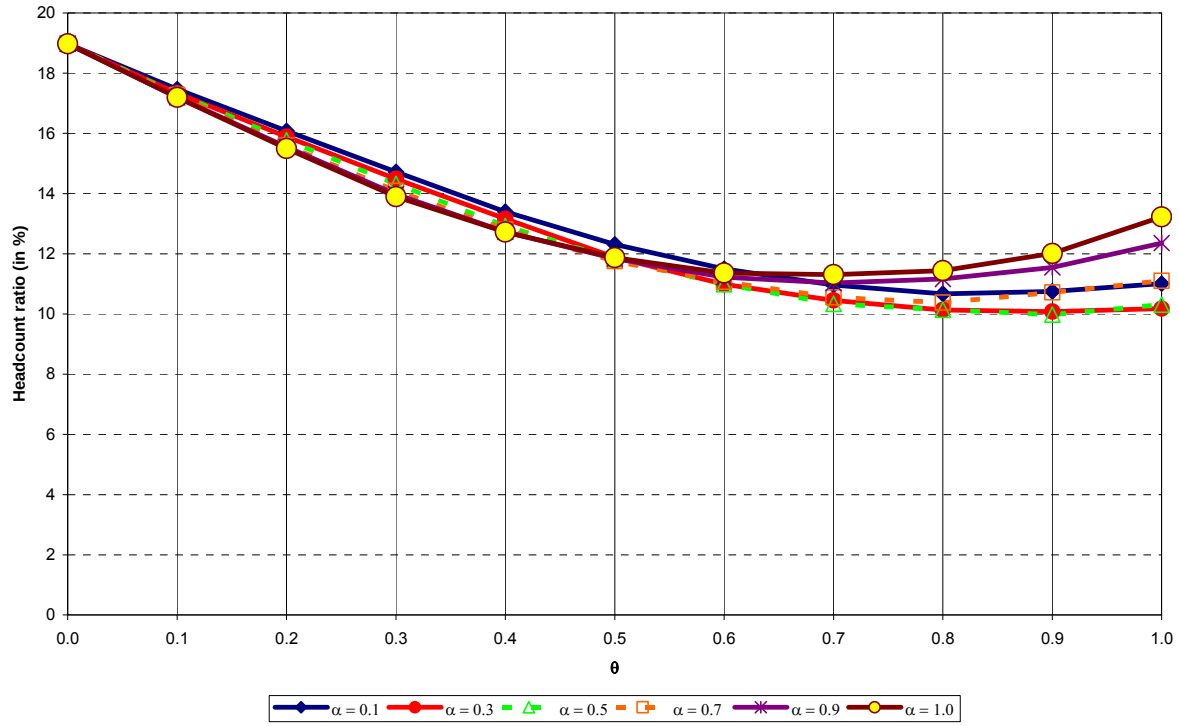


Source: Own computations (see Faik 2008, p. 34, too)

5.4 Relative income poverty in Germany with regard to alternative equivalence relations

Figure 13 deals with poverty-related effects of Citro/Michael's equivalence formula. Obviously there are no big differences compared to the Buhmann et al. formula. Again starting with $\theta = 0.6$ there only is a (very) small tendency for increasing poverty with an increasing parameter α. At $\theta = 0.6$ no important difference between the two approaches is observable, and at $\theta = 0.8$ the corresponding difference is not above 1.5 points.

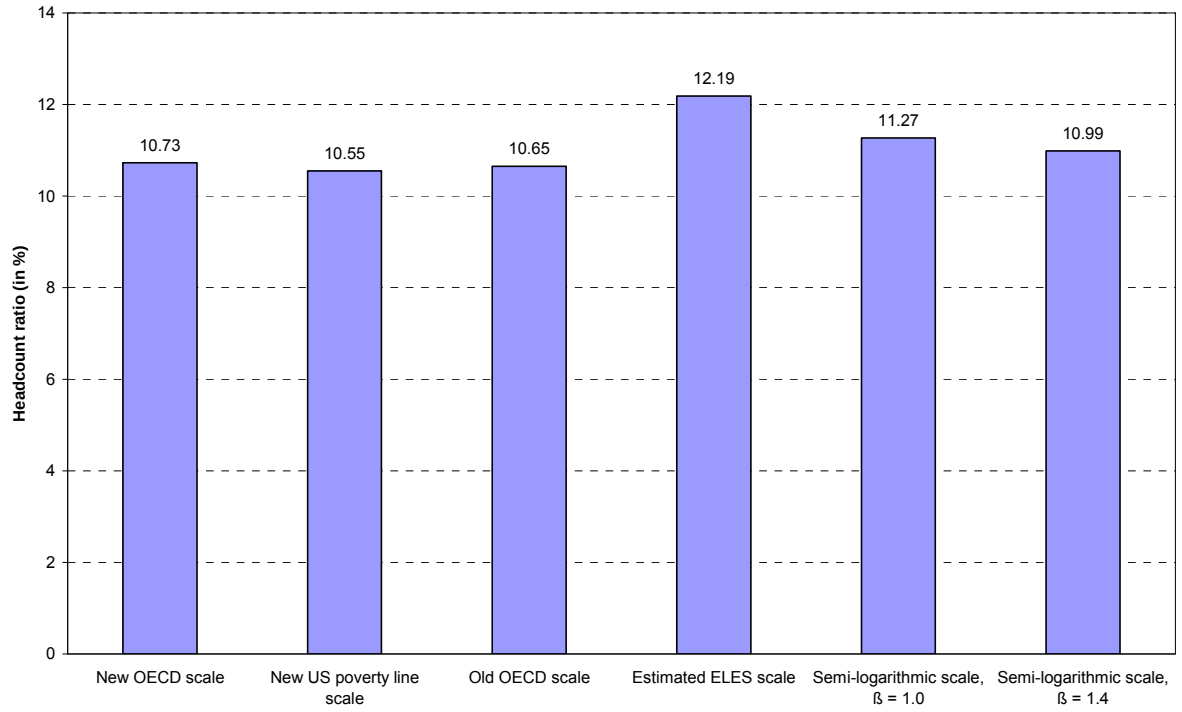
Figure 13: Headcount ratios for Germany in 2003 based on the Citro/Michael formula



Source: Own computations

In figure 14 alternative sensitivity results with regard to relative income poverty are presented. They are based on different equivalence scales. Once again the differences compared to the Buhmann et al. or the Citro/Michael approach are relatively small. The poverty rates range from 10.55 to 12.19 merely.

Figure 14: Headcount ratios for Germany in 2003 based on different equivalence relations



Source: Own computations

6. Concluding remarks

The results of this paper reveal the sensitivity of distributional results due to different equivalence relations. Despite some variation in the results there are a lot of strong general conclusions.

So we observed that the income inequality in Germany decreased between the end of the 1960s and the 1970s. Subsequently inequality increased in Germany gradually – with the exception of the comparison between the years 1998 and 2003. Relating to relative income poverty there has been a similar tendency.

Our results are influenced not very much by alternative equivalence relations formulas. In this sense – and remembering the relatively small variations of income inequality and relative income poverty across time on the comparatively general distributional level we chose – we can answer the questition implicitly asked in the header of this article “Is there stability in the overall German personal income distribution?” with a relatively strong “Yes, there is!”

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